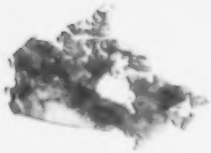

WHAT EVERY SMARTDRIVER SHOULD KNOW

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INTRODUCTION TO FUEL EFFICIENCY

As a professional driver, you see it every day. More and more vehicles are travelling Canadian roads – many of them picking up and delivering products that keep our economy humming. You may have also noticed that the number of heavy-duty vehicles on the road is increasing every year, and they are travelling farther than ever before, consuming more fuel. More than 27 percent of all greenhouse gas emissions in Canada are produced by the road transportation sector, and heavy-duty vehicles account for 19 percent of this total.

For every litre of diesel fuel your truck consumes, 2.7 kilograms of carbon dioxide (CO_2) are released into the atmosphere. In the case of gasoline, every litre used produces 2.4 kilograms of CO_2. Carbon dioxide is a major greenhouse gas that contributes to climate change. Exhaust emissions are also a major cause of urban smog, acid rain and other air pollution problems.

Truck and engine manufacturers have improved the design and capabilities of heavy-duty vehicles. The use of lightweight components in the manufacturing of vehicles is reducing truck weight, which means companies can increase their payload and revenues as well as reduce unloaded fuel consumption.

Improving fuel consumption not only benefits the environment, it cuts down fleet costs. Other than labour costs, fuel costs are the largest expense for a fleet operation, and keeping these costs as low as possible helps companies stay competitive.

But technological improvements won't make much difference if the vehicle is not operated efficiently. As a driver, you have a direct impact on fuel consumption. According to a study by the Technology and Maintenance Council (TMC) of American Trucking Associations, a truck driven using poor driving habits can consume up to 35 percent more fuel than a truck driven using fuel-efficient driving techniques. An improvement of even 10 or 15 percent in fuel economy – which is possible with only a few changes in the way you drive – can save a company thousands of dollars a year per vehicle in fuel and maintenance costs. Our environment will also benefit from the reduction of thousands of kilograms of CO_2 being released into the atmosphere. Driving fuel-efficiently is good for the bottom line and good for the environment.

So what's in it for the driver? If you're an owner-operator, saving fuel means money in your pocket. If you work for a fleet company, helping your employer save money could mean increased job security. Some companies even offer incentives for fuel-efficient driving, such as cash bonuses, free trips or employee recognition.

To encourage fuel-efficient driving, the Transportation Program of the Office of Energy Efficiency of Natural Resources Canada has developed SmartDriver, a training package for professional drivers. SmartDriver recognizes that fuel-efficient driving requires a higher level of driving skills, and it aims to give drivers the tools to save fuel on the road. Fuel-efficient driving is also safe driving and can enhance the image of drivers and the trucking industry.

This booklet is based on the SmartDriver for Heavy Vehicles training module. It provides information on how you can be a

more fuel-efficient driver and covers everything from how the diesel engine works to useful tips on driving your vehicle with fuel efficiency in mind. Since you've participated in SmartDriver training, this booklet will serve as a handy reminder of lessons learned.

DIESEL ENGINES — A PRIMER

Diesel engines are widely used in heavy-duty vehicles for two reasons: they can generate the power and torque needed to move heavy loads, and they are economical compared with other types of engines. Diesel engines typically last three to four times longer than their gasoline counterparts. The high compression ratio of diesel engines (up to 23-to-1, whereas gasoline engines average 9-to-1) requires diesel engines to have a stronger, more durable design to contain the combustion. Therefore, the engine has to be engineered to higher specifications. However, like other combustion engines, diesel engines release carbon dioxide and other pollutants into the air.

The amount of emissions produced by a diesel vehicle depends on

- the design of the engine
- how well the vehicle is maintained
- the quality of the fuel
- most important, how much fuel is used

As a driver, you directly affect the level of emissions produced by your vehicle through your driving technique because you control the engine's running time, speed and performance. The following explains how the diesel engine works and different types of diesel fuels. Later, we will look at how your driving habits affect fuel consumption.

HOW THE DIESEL ENGINE WORKS

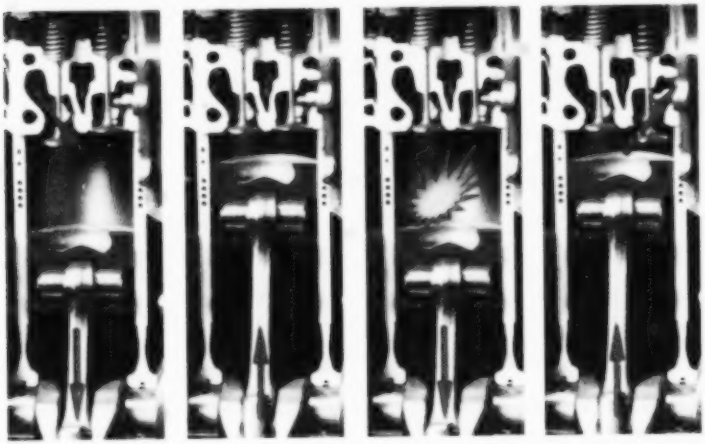
For an engine to move a vehicle down the road, it must convert the energy stored in diesel fuel into mechanical power at the drive wheels. A four-stroke diesel engine works as follows:

Intake stroke – The process begins with the piston moving downward, drawing fresh air into the cylinder through the open intake valve.

Compression stroke – The piston moves upward, and the air is heated by being compressed. Near the top of the stroke, fuel is injected and the hot air ignites the fuel. The amount of fuel injected is controlled by the driver, using the accelerator. If more power is needed, the driver pushes the accelerator farther down, which injects more diesel fuel.

Power stroke – The burning gases expand and force the piston downward. The rod connecting the piston to the crankshaft forces the crankshaft to turn in a circular motion to generate power. This power is eventually applied to the wheels, after passing through the transmission, drive shaft, differential and axle, to move the vehicle.

Exhaust stroke – As the piston moves upward, the combustion gases are expelled through the open exhaust valve and the cycle is complete.



Air is drawn into the cylinder.

Air is heated by compression.

Diesel fuel is injected into the cylinder.

Air–fuel mixture ignites.

Piston turns the crankshaft.

The piston on the upward stroke emits the exhaust gases.

HORSEPOWER/TORQUE

Manufacturers have responded to demands from the trucking industry for diesel engines that are smaller, lighter and more economical and that last longer and produce fewer exhaust emissions. These new engines also have better horsepower and torque characteristics:

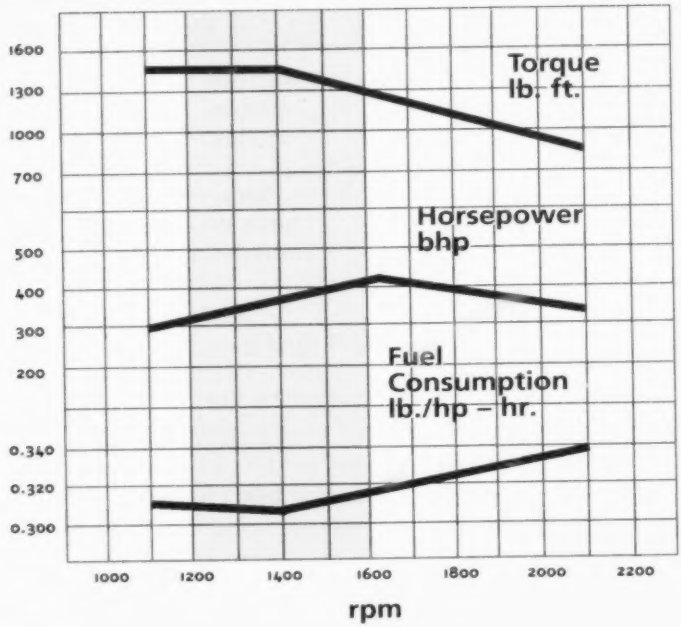
Horsepower – Compared with earlier diesel engines that produced

power at high revolutions per minute (rpm), today's engines produce high power at lower rpm and extend the power over a wider rpm range. The result is more power at cruising speeds, the rpm range where you drive the most.

Torque – Today's diesel engines also produce high torque at lower rpm and spread the torque out over a wider rpm range. More torque at lower rpm means that you can climb hills more easily and with less shifting.

With today's engines, the best fuel economy is usually obtained by downshifting at about 1200 rpm and upshifting at about 1600 rpm.

Typical Torque, Horsepower and Fuel Consumption of a Diesel Engine



Another benefit of new engine design is lower repair and maintenance costs. Since the engine revs less, the components last longer.

TYPES AND PROPERTIES OF DIESEL FUEL

The properties of diesel fuel vary depending on the type of crude oil used to make the fuel, the processing it has undergone and the additives used. In Canada, the limit for sulphur content in low-sulphur on-road diesel fuel is 500 mg sulphur per kilogram of fuel. With the introduction of ultra-low sulphur fuel, the sulphur content will change to 15 mg sulphur per kilogram of fuel on September 1, 2006, in the southern part of Canada and on September 1, 2007, in the north.

When purchasing diesel fuel, you should ask about the fuel's cetane number. A cetane number is a measure of the fuel's capability to self-ignite in a diesel engine. The higher the cetane number, the greater the fuel's tendency to self-ignite. Cetane numbers generally range from 40 to 60. If you purchase diesel fuel with a cetane number that is too low, the engine will be difficult to start. Engine knocking and white smoke from the exhaust are also signs that the cetane number is low. Ask about company policy or follow the manufacturer's recommendations for cetane levels.

Diesel fuel comes in "winter" and "summer" types. If you are driving in cold weather, consider buying winter diesel fuel. Unlike summer diesel, winter diesel fuel contains a different blend of additives to prevent it from forming wax crystals or gelling, which can solidify and plug fuel filters, causing problems starting and operating your vehicle. Winter diesel is widely available in Canada and the northern United States.

> Be aware that summer diesel could form wax crystals while you are travelling in colder areas.

Although summer diesel gives up to 3 percent better fuel economy, it can cause problems in colder months, as it freezes below 0°C.

Premium diesel refers to fuels that have been blended to improve engine performance and durability. Premium diesel can be blended specifically to improve certain properties such as cetane number, low temperature operability, stability, lubricity, detergency, or heating value. However, since there are no universal standards to define premium diesel, you may not always get what you pay for. To justify the extra cost, premium diesel should meet the Engine Manufacturers Association's standard classification number FQP-1.

ALTERNATIVE FUELS

All alternative fuels offer air quality benefits, and some have the additional advantage of producing fewer greenhouse gas emissions.

Many manufacturers now offer alternative-fuelled versions of their heavy-duty engines. These include compressed natural gas (CNG), liquid natural gas (LNG) and propane. Alternative-fuelled vehicles are usually more expensive because of premiums on engines to cover developmental costs and the special tanks required to store the fuel on the vehicle. However, under the right conditions (high-use vehicles with the availability of a low-cost alternative fuel source), an alternative-fuelled vehicle can save the owner significant amounts of money through fuel-cost savings.

GETTING THE MOST OUT OF YOUR VEHICLE

This section examines some of the steps you should take to improve the fuel efficiency of the vehicle you drive.

READ THE MANUAL

The trucking industry is in a state of almost constant change, and you need to stay on top of new technologies in order to drive your vehicle efficiently and effectively. The owner's manual is a source of important information on a vehicle's capabilities and limitations. The manual will explain items that are specific to the vehicle, such as

- shift pattern
- peak torque rpm (the rpm level where the engine produces the most torque)
- operating range (engine rpm where peak torque is available)
- maximum governed speed
- idle speed
- peak horsepower

The knowledge you gain from reading the manual will make the truck easier to drive, which will improve fuel efficiency and reduce wear and tear.

> If the manual for your truck is not in the cab, ask your shop supervisor for a copy.

VEHICLE SPEC'ING

Proper vehicle spec'ing is one of the most important steps in ensuring a fuel-efficient operation. But unless you are an owner-operator, you won't have much say in truck spec'ing. However, if you can see ways to improve fuel efficiency by adding or changing certain components of the vehicle, let your manager know.

For owner-operators, more information on truck spec'ing for fuel efficiency is available from the Transportation Program of Natural Resources Canada's Office of Energy Efficiency (OEE). Write to the address on page 46 or go to the Web site at fleetsmart.gc.ca for a FleetSmart registration form.
As well, vehicle manufacturers have spec'ing software that can simulate vehicle performance and help identify the right components, engine horsepower, torque requirements and driveline choice for your type of operation. These programs may favour the manufacturer's own vehicles, so shop around to make sure you get the best value for your dollar.

PREVENTIVE MAINTENANCE

Preventive maintenance – the regular servicing of a vehicle according to a schedule that is based on the time between servicing, the distance travelled or the amount of fuel consumed – is a key factor in ensuring fuel efficiency. A poorly maintained vehicle will waste fuel, no matter how well you drive it. With preventive maintenance, you can also avoid unexpected break-downs on the road, and small problems can be fixed before they develop into large, expensive ones.

Maintenance should be carried out only by a qualified and trained technician. Your company may have its own in-house shop or it may contract the work to an outside garage. Owner-operators

should also leave preventive maintenance to the experts unless they are trained mechanics.

This doesn't mean that drivers should ignore the maintenance requirements of their vehicle (see **Vehicle Inspections** following). Drivers are responsible for routine service items such as checking and adding engine oil, coolant and windshield washer fluid, and draining moisture from fuel and air systems. As well, the overall state of the truck, trailer and cargo is the driver's responsibility when the rig is on the road.

VEHICLE INSPECTIONS

Your safety and the safety of others is at stake every time you get behind the wheel. It is a legal requirement in Canada to inspect all commercial vehicles before they are taken on the road in order to ensure they are safe.

Pre-trip inspections, along with en route checks and post-trip inspections, have the added benefit of reducing fuel and maintenance costs. A SmartDriver uses inspections to keep his or her vehicle in top condition so that fuel use is minimized.

Inspections also help prevent breakdowns. Many breakdowns are caused by problems that could have been identified in a thorough pre-trip inspection, such as loose or worn fan belts, punctured or leaking radiator hoses; low oil, coolant or power steering fluid levels; or flat tires. When you factor in the costs of towing a disabled vehicle, repairing the truck and providing a replacement vehicle and driver to avoid late delivery, breakdowns can easily double the cost of a routine run.

Inspections should be done systematically to avoid missing important items. Establish a routine and take the time needed. Missed or sloppy inspections can compromise safety and fuel efficiency.

PRE-TRIP INSPECTION

Safety starts with the pre-trip inspection. Remember, this is the law. As a driver, it is your responsibility to make sure the inspection is done according to regulations and the manufacturer's recommendations.

Before beginning a pre-trip inspection, make sure the vehicle is on level ground so that all fluid levels will be accurate. Then raise the hood/cab of the truck and check the following items:

- All fluid levels (oil, coolant, power steering, etc.). Low levels can affect vehicle operation and cause mechanical breakdowns and premature wear.
- All hoses and connections for any sign of leaks. You should also look for fluid leaks from the engine, transmission, radiator and fuel and brake lines, all of which can lead to breakdowns.
- The condition of fans.
- Drive-belt tension. Batteries will not be fully charged if the drive belt is loose or worn.
- The turbo lubrication line (if the vehicle has a turbocharger) to ensure it has sufficient oil.
- Wires in the electrical system to see if they are loose, corroded or damaged.
- The fuel, steering, exhaust and brake systems for loose components.
- The suspension system that is visible under the hood/cab for damage to any components.

> Often an engine in good condition will find its own oil level between the "full" and "add" marks. Therefore, adding new oil to the full mark may be wasteful. Get to know your engine's tendency.

When topping up oil and other fluid levels, be careful not to over-fill; this can cause as much damage as under-filling. Clean up any fluids accidentally spilled to reduce the possibility of a fire.

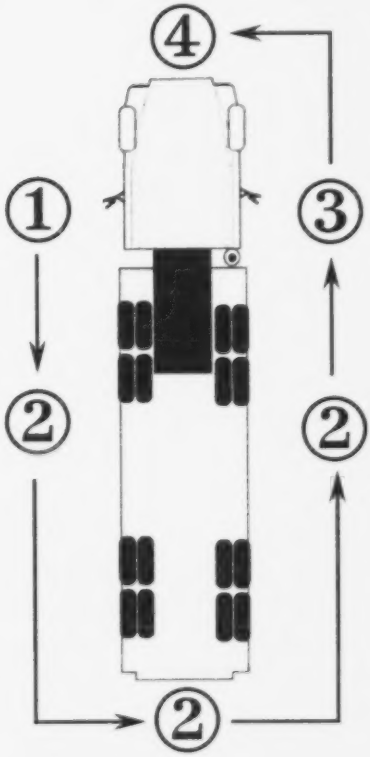
Lower the hood/cab, and turn your attention to inside the cab. Check the position of the driver's seat, making sure you can operate the pedals comfortably while maintaining good back support. Seat belts should also be checked for proper operation. Adjust mirrors as necessary, and make sure the doors and windows on the driver's side and the passenger side of the cab open and close freely. Windows and mirrors should also be cleaned for maximum visibility. After starting the engine, check all instruments and controls to ensure trouble-free operation, including the steering wheel, accelerator, clutch and transmission.

Special attention should be given to the brakes. First, check the low-air-pressure warning system and pressure build-up time (the vehicle manual will explain how). Any problems must be corrected before you set out on your trip. If the pressure is good, use the following routine to ensure proper brake operation:

- Apply the parking brake and try to move the vehicle forward.
- Release the parking brake, apply the trailer brake (using the hand valve), and try to move the vehicle forward.
- Release the trailer brake and move the vehicle forward 3 to 4 metres (10 to 15 feet) before applying the service brake to test the braking response.

Once you're satisfied that the brakes are working, check all other safety items. Test the horn, the wipers (replace damaged

wipers immediately), washer pump, heater, defroster and air conditioner. With the engine running, listen for unusual noises and engine surging.



CIRCLE CHECK AROUND THE VEHICLE

Inspect:

1. **Driver's side of tractor, rear of tractor**
2. **Driver's side of trailer, rear of trailer, passenger side of trailer**
3. **Passenger side of tractor**
4. **Front of tractor**

The final step in a pre-trip inspection is to do a "circle check" around the vehicle. Turn off the engine and, beginning on the driver's side of the tractor (so that you are facing oncoming traffic), circle the entire rig. Don't forget to inspect between the tractor and trailer and under the rig.

During the circle check, make sure that all lights and signals are operating properly. As well, check the condition of all tires and rims (for more details, see **Tires, Wheels and Maintenance** on page 19). Listen for air leaks and drain the air tanks. You should also check the following:

- the suspension system and shock absorbers for damage or signs of excessive wear
- the steering system, axles, drive shaft(s), frame and cross members, and the fifth wheel for cracks, loose or missing bolts or bent components
- the air brake system for:
  - low pressure regulator operation
  - amount of air needed to actuate parking brakes
  - system air loss
  - compressor performance
  - cracks in the brake drums and the slack adjusters to see if they are correctly adjusted
- air and electrical lines to ensure they are secure and undamaged
- the battery terminals for indications of corrosion (to avoid starting problems, terminals should be clean and tight)
- the batteries for proper fluid levels
- aerodynamic accessories to ensure they are secure
- the operation of the power tailgate, loading ramp and trailer or van doors

Look for damage to the body and make sure that licence plates are securely attached. Check to ensure that the load itself is secure (if tarped, make sure the tarp is tight and tied at the corners to reduce aerodynamic drag).

It's also a good idea to take another look at the engine. Since the engine was turned on when you checked the in-cab instruments, controls and

brakes, all system pressures will be up and it will be easier to detect leaks in the lubrication, cooling, fuel or compressed-air systems.

Complete your vehicle inspection report. It is a legal requirement. Any safety-related defect must be corrected before further vehicle operations.

EN ROUTE INSPECTIONS

A professional driver continuously monitors the operation of his or her vehicle throughout a trip. This involves:

- regular checks of all gauges to ensure readings are within the manufacturer's specifications
- monitoring the tires and cargo using mirrors and the "feel" of the rig on the road
- monitoring engine and transmission noises

Regulations for en route inspections vary from jurisdiction to jurisdiction, and your company may have its own policy. Generally, it's good practice to carry out the first en route inspection within 40 kilometres of the start of the trip. At this time, inspect the cargo and load-securing devices.

Complete walk-around inspections of the rig should then be done every three hours or 240 kilometres, whichever comes first. If you are carrying dangerous goods in the United States, you are required to check tires and wheel components every two hours or 160 kilometres, whichever comes first. In Canada, carriers of hazardous waste or explosives must inspect their tires and wheel components every two hours or 200 kilometres.

En route inspections are also an ideal time to stretch, get some exercise and refresh yourself. Reaction time increases after long periods of driving. **An alert driver is a safer, more fuel-efficient driver.**

When carrying out an en route inspection, circle the vehicle as you did during the pre-trip inspection and check the tires, wheel hubs and brakes for excessive heat (place your hands near, not on, the brakes). As well, look for coolant, oil or fuel leaks and make sure all lights are working. Check that the load and all doors are tightly secured.

POST-TRIP INSPECTION

Once you've completed your trip, carry out a final, systematic circle check of the vehicle. Look for any damage to the vehicle, check all fastening devices, and record any maintenance requirements or problems on your daily vehicle condition report (post-trip reports are mandatory in some provinces and territories). Water should be drained daily from fuel tanks.

TIRES, WHEELS AND MAINTENANCE

Proper tire maintenance is essential for safety and fuel efficiency. Unfortunately, tires are often overlooked by drivers during pre-trip and en route inspections. As one driver explained, "If it's round, it's okay." But tires are more complex than this.

During the pre-trip inspection, check your tires for

- depth of tread
- cuts

- scuffing
- sidewall condition
- uneven tread wear (a sign of misalignment)

During en route inspections, use a hammer to "thump-test" the tires; a tire that is flat will produce a different noise than an inflated tire when struck with a hammer. Hit the tire on the tread, not the sidewall (hitting the sidewall can cause damage, including dislodging the tire if it is mounted on a split rim).

Tires must be inflated to the pressure recommended by the tire manufacturer to achieve maximum safety, performance and fuel efficiency. Tire pressure should be checked with an accurate tire gauge at least once a week. Check the pressure before you start a trip when the tire is cool (hot tires will have a higher pressure, and it takes only a few kilometres to heat up a tire). Always replace valve stem covers when the inflation check is done to prevent slow leaks from the valve.

Some drivers deliberately drive on under-inflated tires for a smoother ride. This practice wears out tires and increases fuel consumption. For every 10 pounds per square inch (psi) of under-inflation, tread wear increases by about 15 percent and fuel consumption increases by about 1 percent. Under-inflation can also cause sidewall damage, which can shorten the life of the tire by half. In some cases, under-inflated tires can cause loads to shift on corners and damage the goods you are transporting. Loss of control of your vehicle due to under-inflated tires can also result in rollovers.

Under-inflation is not the only cause of tire damage. Hitting the curb when parking can damage sidewalls and throw wheels out of alignment. Misalignment is a major cause of tire wear and can increase fuel consumption by up to 25 percent.

High-speed driving also reduces tire life. Travelling at 110 kilometres per hour can reduce tread life by 20 percent as opposed to travelling at 90 kilometres per hour.

ADD-ON DEVICES

Certain add-on accessories can significantly reduce the fuel consumption of heavy-duty vehicles. For example, drag-reducing devices can improve the aerodynamics of a vehicle, meaning the engine won't have to work as hard to overcome air resistance, which saves fuel (see **Reducing Aerodynamic Drag**, page 21).

Some engine-related accessories can improve productivity and fuel efficiency, especially when the engine is cold. For trucks operating in temperatures below 0°C, the following accessories should be used, when available:

- Oil pan heaters and block heaters will help your engine to start and reach its normal operating temperature more quickly, where it will use less fuel. As well, warm oil flows more easily, which helps engine components last longer.
- Fuel heaters prevent freezing in the fuel system, which can clog the filters and fuel lines and form wax crystals. The formation of wax crystals will make engine operation difficult and may even cause stalling.
- Thermostatically controlled engine fans, called thermo or viscous fans, use less horsepower than fixed fans (which rotate constantly) and can improve fuel efficiency by up to 5 percent.
- Radiator shutters shorten warm-up time and save fuel.
- Winter fronts, if permitted by the engine manufacturer, can keep the engine warmer by blocking airflow through the radiator.

- A battery blanket will help start the engine in sub-zero temperatures. If there is no electrical source nearby, pack foam insulation around the battery.
- In-cab auxiliary air heaters can heat the sleeper compartment using only 5 percent of the fuel required to keep the engine idling.

REDUCING AERODYNAMIC DRAG

As a tractor-trailer combination moves down the road, the engine has to overcome the air's resistance to being pushed out of the way and the turbulence caused by the vehicle as the air slips around it. The amount of aerodynamic drag depends on the speed of the vehicle, its frontal area, the cab-to-trailer gap and the aerodymanic profile of the trailer box or whatever is being pulled. Higher speeds, bigger frontal areas (non-streamlined), large trailer gaps and exposed trailer facings all increase the engine horsepower required to overcome aerodynamic drag. A fully loaded 36 300-kilogram (80 000-pound) tractor-trailer travelling on a smooth asphalt road needs about 70 horsepower just to overcome air resistance at 90 kilometres per hour. And running light or empty does not necessarily reduce drag.

Drag-reducing devices cut down on wind resistance at highway speeds by smoothing the flow of air around the vehicle. Reducing aerodynamic drag by 10 percent will improve highway fuel efficiency by 5 percent. Consider these tips:

- When the load is high, air deflectors save fuel. However, when the load is low, if possible, lower the air deflectors.
- Whenever possible, reduce the gap between the tractor and trailer to save fuel. TMC found that reducing the gap by 25 centimetres (10 inches) improved fuel economy by 0.5 to 1 percent. When the gap was reduced from

165 to 63.5 centimetres (65 to 25 inches), fuel economy improved by up to 5 percent.

Note : Drivers should be aware that moving the fifth wheel to change the trailer gap may also change the axle loading which could put you in a non-compliance situation or even adversely affect the handling characteristics of the vehicle.

- If you are pulling a flatbed trailer, try to arrange your load in an aerodynamic way so that the air flows smoothly over and around it. As well, covering your load with a tarp will reduce drag.

ON-BOARD COMPUTERS AND ELECTRONIC CONTROL MODULES

More and more fleet companies are turning to computers to improve their operations. Computers can also help drivers assess their performance so they can take corrective actions to improve fuel consumption and safety.

Computerized trip reporting systems use sensors installed in the engine and other drivetrain components to feed data to a small, on-board computer. These systems can record and analyse data on trip distance, vehicle speed, engine speed, over-revving, idle time versus road time, the number of brake applications and at what speed, and total fuel consumption. The data is then downloaded to a central computer, where it can be used to produce reports for management and the driver. By reviewing these reports, you can determine whether you are driving too fast, idling the engine too long or revving the engine too high.

Computers can also be used to reduce driver waiting time, to avoid backtracking and to help drivers avoid trouble spots on the road. Satellite tracking systems and two-way communication devices allow dispatchers and drivers to be in contact at all times.

Dispatchers can immediately inform drivers of any changes in pick-up or delivery schedules and can give routing advice to help drivers avoid accident scenes or road construction. Being in constant touch with dispatch also allows drivers to request help (for example, during a breakdown) at any time without leaving the cab of the truck.

Computers are also being used to control vehicle operations. All new diesel engines are equipped with an electronic control module, or ECM, that can be programmed in the shop to

- limit the vehicle's top speed on level ground
- limit the available road speed in different gears to encourage the use of the top gear
- set cruise control speeds
- set the engine idle speed
- set progressive shifting points (see **Progressive Shifting**, page 34)
- establish power take-off (PTO) settings
- monitor maintenance requirements
- automatically shut down the engine after a specified period of idling

Before driving a vehicle, you should know what settings have been programmed into the ECM.

GETTING THE MOST OUT OF YOURSELF

Now that we've looked at the vehicle itself, it's time to consider how you can improve your driving habits to achieve maximum fuel efficiency. This section discusses issues such as route planning, managing idling time, progressive shifting and minimizing speeding and braking.

PLANNING YOUR ROUTE

You may not always have the option of planning your route. But when you do, here are some time- and fuel-saving approaches to consider:

- If you are making multiple pickups or deliveries, plan them in a logical order to avoid backtracking or crisscrossing a city.
- For long distance trips, plan "backwards" by first determining the specified delivery time and then estimating how long it will take to get there economically and safely. Build in time for rests and a safety margin for unexpected problems or delays.
- Use the latest road maps to plan your route, taking into account any road restrictions and all provincial/territorial/state regulations on truck size, capacity, weight/volume or cargo.

Experience enhances efficiency. Every time your trip takes you to a familiar area, the more efficient you will be. You will be more aware of the best and most efficient stopping locations and routes to your customer's destination.

When planning your route, keep in mind that driving on a four-lane highway is generally more fuel-efficient than using a two-lane highway. A study conducted by TMC found that fuel economy improves by 4 to 11 percent when you use a flat multi-lane highway instead of a two-lane highway because there is a better flow of traffic and less "stop-and-go." Follow your company's routing instructions. There may be other reasons for taking certain routes, such as traffic volume, border-crossing issues, toll roads, etc.

Terrain also affects fuel economy. Where possible, plan your route to avoid mountainous terrain to save fuel and time. Mountainous routes tend to be harder on brakes, which increases maintenance costs, and can be subject to frequent weather changes that can affect fuel efficiency and travel time.

If possible, you should also plan your route to avoid driving through suburban areas (use bypass roads around major cities), since stoplights, intersections and pedestrian traffic all mean multiple stops and starts. The TMC study found that fuel efficiency improved by 45 percent or more when driving on a flat, multi-lane highway instead of a suburban route with constant stop-and-go traffic. As well, try to avoid areas where you know road maintenance work is underway.

If your company has a designated routing expert, work with this individual to determine the best route from a time and fuel efficiency perspective. More and more companies are using routing software to determine the most logical sequence of deliveries for each truck and each route. Many also use automated dispatching

programs to select drivers, vehicles and routes to produce the most efficient driver schedule.

ADVERSE WEATHER CONDITIONS

A truck encounters "rolling resistance" when it is in motion. Many factors affect the amount of resistance, including weather conditions.

For example, driving through snow can increase fuel consumption by 15 to 20 percent, since the vehicle has to "push" harder to move through the snow. Heavy rain can also increase rolling resistance and can increase fuel consumption by up to 10 percent compared with dry-road operating conditions.

As the temperature lowers, engine oil, transmission fluid and axle lubricants thicken and resist flow. This thickening will result in higher fuel consumption when the vehicle starts moving after a prolonged stop. You can reduce this condition by using synthetic lubricants.

Wind has a significant effect on fuel efficiency since it increases aerodynamic drag and causes the engine to work harder to maintain the same speed. The study conducted by TMC determined that fuel economy can improve by up to 10 percent if there is no head wind compared with an eight-kilometre-per-hour head wind. The study found the same results for crosswinds.

Weather factors are out of your control, but you can take steps to minimize their impact on fuel efficiency. For example, watching the weather channel can help you avoid bad weather whenever

> In winter, cool off your tires by moving your vehicle back and forth in the snow before parking. Stop in the path you have created so you will have traction to pull out later. If possible, don't apply the trailer brakes until the drums have cooled off.

possible, perhaps by starting your trip earlier or later than originally planned. When on the road, listening to the radio and CB can warn you about adverse conditions that you may be able to bypass.

You should also adjust your driving to suit the conditions. If there is a strong head wind, reduce your speed by 10 kilometres per hour to avoid wasting fuel.

If possible, rest during the day, when it is normally warmer. This can reduce the amount of fuel used for cab heating. Use a high-quality, well-insulated sleeping bag, and make sure your cab is insulated for Canadian weather.

When parking your rig on ice, try to pick a slope that will help you move forward when restarting. After a trip, your tires are warm and will melt holes in the ice. If you park on an uphill slope or even on level ground, your wheels may spin trying to get out of these holes, leaving your truck stuck in ice, wasting time and fuel.

ROAD CONDITIONS

Road conditions will also affect fuel efficiency because different road surfaces create different rolling resistances. Smooth concrete and asphalt have the least rolling resistance compared with roads that are made up of hard-packed soil, loose gravel or sand. This means that you will get better fuel efficiency on the highway than off-highway.

Driving on winding roads will also consume more fuel than driving on straight roads, since the truck has to take each bend at a safe speed and then build up speed on the straight stretches.

STARTING AND WARM-UP TECHNIQUES

Proper vehicle starting and warm-up techniques can save fuel, reduce maintenance requirements and save your company money.

STARTING THE ENGINE

It is not necessary to pump the throttle of a fuel-injected engine. The amount of fuel required for starting is pre-measured. As well, limit cranking time to 30 seconds. If the engine does not start, wait two minutes for the starter motor to cool and try again.

For cold-weather starting, place the transmission in neutral and depress the clutch. This will enable the engine to turn over faster and make starting easier. Below 0°C, some engine-related accessories such as oil pan heaters and block heaters can make starting easier, decrease engine wear and improve fuel efficiency (due to quicker warm-up time). For more information on cold-weather aids, see **Add-On Devices** on page 20.

COLD-START IDLING

Once the engine has started, let it idle. When the pressure gauge shows the oil pressure dropping, increase the engine speed to around 900 rpm to allow the oil to warm and circulate. If the oil pressure remains high, it means the oil has not yet warmed and needs more time. Never bring the engine to a high idle to warm it faster as this can cause premature engine wear, especially on piston rings and cylinder walls.

Normally, three to five minutes of idling is sufficient for warm-up. The exception is in cold weather (below 0°C), when you may need seven to 10 minutes of idling for a proper warm-up. Idling any longer than these recommended times only causes unnecessary engine wear, and increased fuel consumption and greenhouse gas emissions.

Did you know . . . ?

Regular and proper warm-ups help components and seals to expand and seat evenly.

STARTING OFF

Once engine warm-up has been completed, it's time to start off. Engine oil will be warmed somewhat, but it will not be at operating temperature, and the drivetrain (transmission, drive shaft, differential, axles and tires) will still be cold. To avoid excessive engine and drivetrain wear, it is important to start out smoothly and slowly. This practice reduces the load on the moving parts until the oil and other fluids that lubricate these components reach their most effective operating temperature. The benefits of an "easy start" are reduced maintenance and improved fuel economy.

When starting off, it's best to choose a gear that allows the vehicle to begin moving without having to use the throttle. The improved low-end torque of today's diesel engines should make starting without the throttle possible in almost any conditions. This practice reduces wear on the clutch and drivetrain.

If you see black smoke, back off the throttle. Black smoke is a sign that the engine is not burning the fuel completely. Reducing throttle may produce more power because the fuel will then be properly burned. Pushing unburned fuel through the engine is not only a waste of money but can also damage the valves, the turbocharger and other components affected by heat and exhaust. If you see blue or grey smoke, the engine is burning lubricating oil, which indicates that it needs maintenance.

TO ETHER OR NOT TO ETHER?
(*NOTE:* DO NOT USE WHERE ENGINE IS NEW.)

Ether is sometimes used to start cold engines. However, it must be used carefully to avoid damaging the engine and should be used

only as a last resort. Using ether too often can cause excessive wear and make it necessary to always use ether when starting the engine. Always refer to the engine's operating manual before using ether. Some engine designs do not allow for its use.

Ether is usually sprayed directly into the air cleaner, where it is drawn through the intake ports and into the cylinders when the piston is on a downward stroke. The ether thins the oil on the cylinder walls, resulting in insufficient lubrication. Although the use of ether helps the engine start, ether increases the wear of liners and rings, and decreases the lubrication properties of the crankcase oil.

Before using ether, make sure the engine is cranking over on the starter. Under no condition should ether be used in combination with intake air heaters; to do so can cause an explosion and damage the connecting rods, crankshaft and other engine parts.

REVVING — WHERE WILL IT GET YOU?

As a general rule, revving the engine will get you nowhere.

This is particularly true on start-up. Cold oil doesn't flow well and will not get to the top of the engine to properly lubricate moving parts. Increasing rpm before adequate lubrication has taken place can cause excessive wear and damage the cylinder rings and walls and other engine components. Similarly, revving the engine when idling will wear out the engine more quickly.

MANAGING YOUR IDLING TIME

Like unnecessary revving, excessive idling wastes fuel and causes premature engine wear. An unloaded, idling Class 7/8 heavy-duty diesel engine uses about four litres of fuel per hour at 900 rpm. The wear on such an engine idling for one hour is equal to one to two hours on the road at cruising speeds for electronic engines and three to five hours for mechanical engines. So managing your idling time is one of the most important ways to improve your vehicle's fuel efficiency and reduce its operating costs.

Once the engine is warm, save fuel (and reduce exhaust emissions) by turning the vehicle off when you stop for any length of time. This will also reduce maintenance costs since fuel injectors can easily become clogged when the engine idles for too long. Keep in mind that idling doesn't keep your engine warm. In fact, for the first hour, the engine will actually stay warmer if it is turned off because an idling engine continues to circulate coolant.

The stop you think will take only five minutes often ends up taking 15 to 20 minutes. Make it a habit to turn off your vehicle's engine whenever possible.

During rest stops, many drivers idle their engines to provide cab heat in winter or air conditioning in summer. For heating, an in-cab auxiliary air heater is a far better option. These devices can heat the sleeper compartment using only 5 percent of the fuel required to keep the engine idling. In other words, the fuel you use to idle an engine for one hour at 900 rpm would operate an in-cab heater for 20 hours.

In summer, air conditioning can add to the high cost of idling, since the air conditioner draws horsepower from the engine. According to TMC, idling (at 1000 rpm) with the air conditioner on can increase fuel consumption by as much as 6 percent compared with idling without air conditioning.

Consider this: if you reduce idling time by only one hour per day for 260 days, your truck will save about 1050 litres of fuel. A 10-truck fleet would save about 10 500 litres, and a 100-truck fleet would save 105 000 litres of fuel. Now you know why your company is concerned about unnecessary idling!

As noted earlier in this booklet, some electronic engines can be programmed to automatically shut down after a set period of idling. ECMs can also measure idling time, so you can measure how you are performing.

CLUTCHING

Clutching refers to the action of depressing the clutch to move the transmission from one gear to another (Note: some new transmissions synchronize engine rpm to road speed, which means that the clutch is used only for starts and stops). Professional drivers pride themselves on smooth shifting and proper use of the transmission – both of which reduce fuel consumption. This takes practice but is the key to minimizing unscheduled downtime due to a damaged transmission.

Most heavy-duty truck drivers use a technique known as double-clutching. This two-step process involves depressing the clutch far enough to break torque in the transmission and move the gear shift lever to neutral. The clutch is then released and depressed again to move the lever to the next gear.

Although double-clutching is important, the key with non-synchronized transmissions is to synchronize the teeth of the matching gears (i.e., the driving gear and the driven gear). "Revs equal to road speed" is a useful phrase to remember when shifting gears. It means that the engine rpm is just right for the new gear at that speed. When this is done properly, there is no grinding or clashing of gears.

Today, most trucks have a clutch brake that is activated when the clutch pedal is depressed close to the floor. A clutch brake slows down the transmission for easier and faster gear engagement and is used to move into low gear or reverse when the vehicle is standing still.

Some drivers choose not to use the clutch. With non-synchronized transmissions, failure to use the clutch, together with each miss of a progressive gear change, causes premature wear of the transmission.

PROGRESSIVE SHIFTING

Progressive shifting refers to the technique of shifting gears before you reach maximum governed rpm. This practice is highly recommended by engine manufacturers, especially for newer trucks with low-revving engines.

With this method, you shift gears when the engine has accelerated to the point where it can handle the load easily in the next highest gear. Whenever possible, you should avoid revving the engine to its maximum speed (especially in the lower gears). This wastes fuel and is not an effective way to reach the highest gear quickly. Testing has shown that progressive shifting can reduce fuel consumption by 8 percent or more compared with shifting at maximum governed rpm. It also reduces equipment wear and lowers noise levels.

Progressive shifting can sometimes mean skipping gears if they are not needed. Use as high a gear as possible without "lugging" the engine. Lugging occurs when the engine speed falls below the normal operating range for that gear. At this point, the engine is producing too little power and struggles, or lugs, to maintain speed. Lugging strains the engine and can cause overheating and damage to the drivetrain.

Read the owner's manual for information on the most effective shift pattern for your vehicle. It's possible that shift points have been programmed into the vehicle's ECM. In this case, a loss of engine power signals that it's time to shift up to the next gear.

You do not have to travel more slowly with progressive shifting. Shifting the transmission sooner allows the engine torque to build up the vehicle's speed. Tests show that you actually save time by using the progressive shifting method.

In applying the progressive shifting method, use your judgment based on the feel of your engine and transmission and your

overall knowledge of the vehicle. The key is to make the best use of the engine's torque rather than using maximum rpm. Remember that peaking in each gear is a fuel-consuming habit that should be avoided.

DRIVING SPEED

As speed increases, so does air resistance, or drag, which opposes the forward motion of your vehicle. The higher the speed, the harder the engine and drivetrain must work to push the vehicle through the air and down the road. Working the engine and drivetrain harder requires more fuel and increases maintenance costs.

The recommended maximum cruising speed for professional truckers is 90 kilometres per hour (your company may have a different policy). Generally, for every 10 kilometres per hour above 90 kilometres per hour, you burn 10 percent more fuel. Higher speeds cause more wear on all parts of the engine and drivetrain. Tires alone can easily wear out 20 percent faster (see **Tires, Wheels and Maintenance**, page 19). As you can see, travelling fast is not only unsafe, it is costly.

One way to manage your road speed effectively is to practise smartDriving (see page 38). Another is to use cruise control. In fact, cruise control is the most efficient way to save fuel on the highway, provided the control is set at a reasonable speed. Some vehicles allow for some speed flexibility within cruise control for uphill and downhill terrain.

> Although cruise control can increase fuel efficiency, it is not efficent or safe on roads that are slippery or that have sharp corners or steep hills. Under difficult conditions, cruise control will keep feeding fuel to the engine, which could easily result in loss of control and increase fuel consumption.

Maintaining speed on an uphill climb is a challenge many drivers try to meet head-on – and that can be bad news for fuel consumption. Increasing your speed to "take a run" at the hill will only waste fuel, since you will inevitably need to downshift to make the climb. Instead, concentrate on using the combination of vehicle speed and transmission gear that will make the best use of the engine's torque to get you up the hill. Allow both your engine and road speed to drop to the point of peak torque before beginning to downshift. Keep in mind that today's diesel engines provide more torque at lower rpm, which means trucks drive up hills more easily with less shifting.

On downhill slopes, take advantage of gravity. Back off the accelerator just before you get to the top of a hill to conserve fuel, and allow the momentum of the vehicle to carry you over the top and into the downward slope. When descending an incline, shift into the lowest gear that will maintain maximum engine braking without exceeding the posted speed limit. This may be two gears lower than the gear you would use to climb the same hill. Try to keep your speed steady while descending, but don't pump the brakes. The best practice for downhill braking is "snub and roll" where you would use short intermittent brake applications to slow the vehicle. This technique allows the automatic slack adjusters to continually adjust the brake stroke and maintains the balance between the tractor and the trailer brakes. When descending a very steep grade, don't rev the engine above the rated speed. This can seriously damage the engine.

At all times, you should be able to stop your vehicle within a reasonable distance, taking into account any curves in the road that may limit how far ahead you can see.

ENGINE BRAKING AND RETARDERS

Retarders can be used to slow down the truck without using the service brake.

The engine retarder works by changing the timing of the engine's valves. In effect, the engine becomes a compressor capable of slowing the vehicle. It is activated by a dash-mounted switch and controlled by the throttle position. When you gear down to the point where the engine easily holds the speed, the engine will run cooler and more efficiently.

Engine retarders have the highest amount of hold-back power at higher rpm. No fuel is wasted since the engine is not using any fuel when the retarder is in use.

Allow the terrain to work for you, not against you. This means using your engine retarder properly and turning it off when you don't need it. Many communities prohibit the use of engine retarders within city limits because of the noise they make.

There are also a number of different types of retarders. An exhaust retarder basically shuts off the exhaust flow from the engine using the resulting back-pressure to slow the engine speed. A transmission retarder uses hydraulic fluid flowing through a series of variable turbines to reduce transmission speed. A driveshaft brake uses electrical or hydraulic clutching devices that can slow the rotational speed of the driveshaft.

ENGINE COOL DOWN

When you're approching a rest stop, let the engine cool down while you're still on the road by backing off the accelerator and using the vehicle's momentum to exit the highway. If you use only a light load on the accelerator while parking, your engine should be cool enough to turn off immediately.

However, if the truck has been working under full power, it needs a period of three to five minutes' idling to cool down. Otherwise, the protective oil film on the surface of heated parts could be burned off. This lack of oil on restart can damage key components such

as piston rings and cylinder walls. Turning an engine off when it is very hot can also damage the cylinder heads, exhaust manifold or turbocharger.

Anything beyond three to five minutes of idling time wastes fuel, especially if you are running accessories such as air conditioning.

SMART DRIVING FOR FUEL EFFICIENCY

Your ability to maintain a relatively constant road speed will have a direct impact on your vehicle's fuel consumption. Defensive driving techniques allow you to conserve your momentum by reading the road and anticipating hazards.

WHAT IS SMART DRIVING?

Smart Driving is driving to prevent accidents in spite of the actions of others around you and road and weather conditions.
It is both an attitude and a skill. Training and awareness help lay the groundwork for good driving practices, but using what you learn every time you get behind the wheel is the key to success.

Smart Driving requires

- knowledge of traffic laws and how to recognize and avoid hazards

- alertness to road, vehicle and driver conditions that affect your ability to drive safely and efficiently
- foresight in looking for problems that lie ahead and preparing for them
- judgment in knowing what choices you have and in making the right decision
- skill at handling your vehicle effectively in everyday and emergency situations

Many companies require their drivers to take defensive driving courses, either internally or through an outside trainer. This section is not intended to replace such training; however, it does provide some defensive driving guidelines that have the added benefit of reducing fuel consumption.

SmartDrivers adjust their driving to suit the following:

Visibility conditions. In bright sunshine or when snow glare is a problem, wear sunglasses and use your sun visor. At night, avoid looking directly at oncoming headlights. Instead, look to the right for road edge markings as a guide. Where light conditions are less than ideal, reduce speed and increase the distance between your rig and the vehicle ahead of you.

The weather. When battling the elements for traction, visibility and vehicle control, slow down and maintain a safe following distance. High winds make steering difficult. Control your vehicle, and anticipate other vehicles swerving into your path. Always keep the windshield, mirrors and all windows clear of snow and ice so you have full visibility. Check that your wipers are in good condition to prevent streaking and smearing, and top off washer fluids.

> Tail-lights must also be kept clean so that drivers behind you will see your vehicle day or night.

Traffic. Try to travel at the same pace as other traffic, staying within the speed limit. If most vehicles are speeding, stay in the right-hand lane. Give way to other drivers if it will avoid a hazardous situation, even if you have the right of way (see **Handling Traffic**, page 40, and **Following Distance**, page 41, for more information).

The vehicle. Always ensure that all vehicle components are in good working order and ensure that your seat is adjusted to the correct position for you.

HANDLING TRAFFIC

Defensive drivers are constantly alert to other vehicles on the road. Using your eyes as your primary line of defence, read the traffic around you for clues that indicate changes in the flow of traffic, such as brake lights and sudden changes in the speed or the direction of the vehicles ahead of you.

If you see a potential hazard ahead, start to slow down and cover the brake with your foot while you decide whether you are going to have to stop. Slowing down early can avoid an emergency stop, which wastes fuel, causes excessive brake wear and, most important, can endanger you and others on the road.

Before passing other vehicles, ask yourself three questions: Is it necessary, is it legal and is it safe? Keep in mind that speeding up to pass uses extra fuel, and you might not be any further ahead if all traffic is moving slowly. Most important, don't let frustration with a slow vehicle impair your judgment.

Before pulling out to pass, make sure you have enough room ahead and behind to safely complete the manoeuvre. Check your blind spots, signal your intention and then pull out smoothly.

Don't try to compete with the speed of other vehicles, including other truckers. Remember, driving at a constant, reasonable speed is smart driving.

When approaching an intersection, be prepared to yield. Start to slow down by taking your foot off the accelerator and covering the brake. If the intersection has traffic lights, be prepared to stop.

Never rely on other drivers to do the right thing. Be prepared to take whatever action is necessary to avoid an accident. Being alert means looking all around your vehicle in case you have to change lanes quickly. Know where your blind spots are and check them regularly.

FOLLOWING DISTANCE

Keeping a safe distance between your truck and the vehicle directly in front of you is an important aspect of Smart Driving. This will ensure that you can brake easily and effectively while maintaining complete control of the vehicle at all times. Keeping your distance also means

- you will not tire as quickly
- you won't react negatively to the actions of other drivers
- you will have a better view of the road ahead
- your peripheral vision will be improved because your concentration does not have to be as focused on the vehicle ahead of you

There should be at least four seconds of travelling distance between you and the vehicle ahead. This will allow other drivers to move in and out of your lane of traffic without forcing you to brake – only to back off the accelerator for a short time.

Remember, four seconds of travelling distance is a minimum; on certain roads or in adverse conditions, you should lengthen the travelling distance between your vehicle and the vehicle ahead.

Bad weather can dramatically reduce visibility, so you should always adjust your speed to be able to stop within the distance you can see ahead.

To judge your following distance, note when the back of the vehicle ahead of you passes a fixed marker, such as a utility pole or light standard. Count how many seconds pass before the front of your vehicle reaches the marker. Anything less than four seconds means you are following too closely to avoid unnecessary braking.

YOUR PHYSICAL AND MENTAL HEALTH

We've talked about weather, road and vehicle conditions. But what about your own condition? It can be the most important factor in a safe and fuel-efficient trip.

Before getting behind the wheel, ask yourself whether you are physically and emotionally fit to drive. If the answer is no, for whatever reason, your trip should be delayed.

Know your limitations and adjust to them. Drivers under age 25 tend to be in good physical condition, but can lack experience and mature judgment. Older drivers have driving experience, but their reaction time may be longer. The ability to see well at night decreases with age and is noticeable after about age 40.

As a professional driver, your job keeps you physically inactive for much of the day. To avoid health problems, try to get some physical activity several times a week. Swimming, walking, hiking, jogging and cycling are good for overall heart and lung fitness. Most important, find something you enjoy and focus more on the duration of activity than its intensity.

Your mental outlook is just as important. Aggressive drivers are not fuel-efficient drivers. Rapid acceleration and excessive braking

wastes fuel and wears out the truck prematurely. Aggressive drivers can also cause accidents through reckless actions.

At all times, you must control your responses to what is happening around you. Losing your temper or reacting negatively will only compound the problem. It can also cause you to lose your focus, as you become preoccupied with the incident that triggered the anger. Similarly, worried or depressed drivers often lose their concentration. If you're not in the right frame of mind, chances are you won't respond to emergencies quickly or rationally. Get your emotions in check before driving your truck.

> **A helpful approach when fatigued is to remind yourself that you want to get home safely after every trip.**

If you are tired, pull off the road for some exercise and fresh air. If this doesn't help, take a nap. Driving when tired can be extremely dangerous for both you and others on the road.

EYESIGHT

Good eyesight is essential for safe driving and plays a vital role in accident prevention. For these reasons, you should have your eyes examined regularly, especially if you are over 40 years of age.

When on the road, stop from time to time to give your eyes a rest. As well, wear good quality sunglasses to protect your eyes against glare.

ALCOHOL AND DRUGS

Alcohol and driving don't mix. Alcohol adversely affects your judgment, reaction time and coordination, even if you drank the

night before. Drinking and driving can cost you your career – and possibly your life.

Prescription and non-prescription drugs can also impair your driving ability. Check with your doctor or pharmacist about any drugs you use. Illegal drug use, like alcohol consumption, severely affects driving skills and is strictly forbidden.

You should also avoid taking stimulants to stay alert, since these substances only delay the feeling of being tired. The stimulating effect can disappear suddenly, bringing on instant fatigue. As well, stimulants can cause hallucinations and impair your judgment and coordination. If you are tired, stop, rest and then resume your trip.

EATING HABITS

Poor nutrition can cause drivers to tire rapidly and lose their concentration. To compensate, many drivers drink large amounts of coffee. For health reasons, it is strongly recommended that you replace coffee with fruit juices and milk products whenever possible.

Here are a few practical tips for improving your eating habits:

- reduce portions
- include fruit and vegetables in your diet
- avoid butter, oil, salt, fatty meats, cream, coffee, cola and alcohol
- eat your meals at regular times each day
- order nutritional foods when eating at truck stops

GIVE YOURSELF, YOUR COMPANY AND THE ENVIRONMENT THE FIVE-STAR TREATMENT

- ☆ SmartDrivers are physically and mentally fit.
- ☆ Slow down.
- ☆ See ahead, and drive defensively.
- ☆ Shift progressively.
- ☆ Shut off the engine.

SUMMING UP

Being a professional driver means more than knowing the rules of the road, understanding safety regulations and getting from one point to another as quickly as possible. You should also be aware of how your driving habits affect fuel consumption, and you should be prepared to do something about it. SmartDrivers:

- have the right mental attitude toward their work, are open to new ideas and are prepared to abandon old habits and learn new techniques

- care about the condition of their vehicles and conduct pre-trip inspections to identify problems that could contribute to unnecessary fuel consumption or on-the-road breakdowns
- plan ahead to avoid the costly starts and stops of city driving, rush-hour traffic jams or racing against the clock to reach their destination
- use progressive shifting techniques and keep idling and revving to a minimum
- practise defensive driving techniques to ensure a smooth, safe and fuel-efficient ride
- are fit, healthy and relaxed drivers

For information on SmartDriver training, write to:

Transportation Program

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Natural Resources Canada's Office of Energy Efficiency

Leading Canadians to Energy Efficiency at Home, at Work and on the Road

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